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PROVISIONAL SPECIFICATION FOR THE INVENTION ENTITLED:

**A Cistern Outlet Valve Mounting Bracket Assembly and A Method of Installing an Outlet Valve
in A Cistern**

Name and Address of Applicant:

**Caroma Industries Limited, an Australian company, ACN 000 189 499, of 10
Market Street, Brisbane, Queensland, 4000, Australia**

Name of Inventor:

Sam Robertson England

This invention is best described in the following statement:

A CISTERN OUTLET VALVE MOUNTING BRACKET ASSEMBLY AND A METHOD OF INSTALLING AN OUTLET VALVE IN A CISTERN

Technical Field

5

The present invention relates to a cistern outlet valve mounting bracket assembly and a method of installing an outlet valve in a cistern. A cistern is known as a flush tank in the United States of America.

10 The invention has been primarily developed for mounting outlet valves in one piece toilet suites (ie. suites that have an integral cistern and pan) and will be described hereinafter with reference to this application. However, it would be appreciated that the invention is not limited to this particular use and, for example, can also be used in mounting an outlet valve in a separate cistern.

15

Background of the Invention

Outlet valves must be installed in cisterns in such a manner as to allow their removal for service and repair. In a toilet suite that has a separate cistern and pan, the outlet valve has a threaded tail which passes through an opening in the bottom of the cistern and is fastened thereto by an external nut. A seal is placed in the potential leak path between the cistern interior and the valve. When the nut is unscrewed from the tail, the outlet valve can be removed from the cistern.

20 In a one piece toilet suite the underside of the cistern is concealed by a shroud that extends from the cistern to the pan. The shroud makes access to the underside of the cistern very difficult, particularly after the suite has been grouted to a bathroom floor.

25 One known arrangement which avoids having to access the underside of the cistern to remove the outlet valve uses the previously described nut to instead clamp a stainless steel mounting plate to the valve tail, with a seal therebetween. A second seal is then placed on the underside of the mounting plate. The mounting plate, and thus the outlet valve, is then fixed to the cistern via two captive bolts in the base of the cistern that pass through holes in the mounting plate.

30 This known arrangement has several disadvantages. Firstly, an additional potential leak path is introduced at the second seal between the mounting plate and the cistern. Secondly, the stainless steel plate is expensive to manufacture and time consuming to

install. Thirdly, the addition of the mounting plate and the second seal increases the overall height of the outlet valve, which can limit the range of cisterns to which it may be fitted.

Object of the Invention

It is an object of the present invention to substantially overcome or at least ameliorate one or more of the above prior art disadvantages.

Summary of the Invention

Accordingly, in a first aspect, the present invention provides a cistern outlet valve mounting bracket assembly, said assembly including first and second bracket members adapted for positioning about an outlet valve in engagement with each other and the valve, said members having means to allow fixing of said engaged members to a cistern.

The members preferably each include a semi-circular recess, each adapted to receive a portion of the outlet valve therein. The recesses preferably have teeth adapted to engage with corresponding openings in the outlet valve.

The members preferably engage at one or more regions, most preferably two, also having said means to allow fixing. Said means to allow fixing are desirably one or more openings in the assembled members that are each adapted to receive a fixing shaft therethrough. In a preferred form, the openings comprise a pair of shaft portions in the first member and a corresponding pair of apertures in the second member, the second member having barbs adapted to engage with the first member. The barbs are preferably adapted to engage with the first member substantially adjacent the shaft portions.

In a second aspect, the present invention provides a method of installing an outlet valve in a cistern, said method including positioning first and second bracket members about the outlet valve and in engagement with each other and the outlet valve and then fixing said engaged members to said cistern.

The members are preferably fixed to the cistern with one or more fixing shafts that pass through corresponding openings in the engaged members.

Brief Description of the Drawings

A preferred form of the present invention will now be described, by way of example only, with reference to the accompanying drawings wherein:

Fig. 1 is a perspective view of an embodiment of a cistern outlet valve mounting bracket assembly according to the invention;

Fig. 2 is an exploded perspective view of the assembly shown in Fig. 1 prior to engagement with a cistern outlet valve;

Fig. 3 is a perspective view of the assembly shown in Fig. 1 partially engaged with a cistern outlet valve;

Fig. 4 is a perspective view of the assembly shown in Fig. 1 after engagement with an outlet valve; and

Fig. 5 is a perspective view of the assembly and valve shown in Fig. 4 installed within a cistern.

Detailed Description of the Preferred Embodiment

Referring firstly to Fig. 1, there is shown an embodiment of a cistern outlet valve mounting bracket assembly 10 according to the invention. The assembly 10 includes first and second moulded, glass-filled nylon bracket members 12 and 14. The members 12, 14 each include a semi circular recess 16, 18 respectively which are each adapted to receive a portion of a substantially cylindrical outlet valve 20 therein. The valve 20 has a tail 22. The recesses 16, 18 include teeth 24 which are adapted to engage with corresponding openings 26 (as best seen in Fig. 2) in the valve 20.

As best shown in Fig. 3, the first member 12 includes two shaft portions 28 and recesses 30. The second member 14 includes two corresponding apertures 32 and barbs 34. When the members 12, 14 are brought together (see Fig. 4) about the valve 20, the barbs 30 engage with the recesses 28 in a position in which the apertures 30 align with the shaft portions 28 and the teeth 24 enter the openings 26.

The installation of the assembly 10 shall now be described. Figs. 2, 3 and 4 show sequentially how the members 12 and 14 are brought into engagement with one another about the outlet valve 20 until they ultimately engage each other, and also the outlet valve 20, to form the valve/assembly 36. Fig. 5 shows the valve/assembly 36 installed within a cistern 38 by passing the tail 22 of the valve 20 through an opening (not shown) in the base of the cistern 38 whilst passing the openings/apertures 28/30 over a correspondingly positioned pair of captive bolts (not shown). The assembly/valve 36 is fixed to the cistern 38 by fastening a pair of wingnuts 40 to the bolts.

base of the cistern 38 whilst passing the openings/apertures 28/30 over a correspondingly positioned pair of captive bolts (not shown). The assembly/valve 36 is fixed to the cistern 38 by fastening a pair of wingnuts 40 to the bolts.

5 A seal (not shown) is positioned between the adjacent surfaces of the interior of the cistern 38 and the exterior of the valve/assembly 36.

It should be noted that the installation in Fig. 5 is shown in relation to a separate cistern for ease of description only. The preferred use of the outlet valve mounting bracket assembly is in mounting an outlet valve to a cistern forming part of a one piece toilet suite.

10 The assembly described above has several advantages over the prior art arrangements. Firstly, the installation of the assembly and the valve described results in only one potential leak path between the assembly/valve and the cistern. Secondly, the assembly may be inexpensively manufactured by injection moulding in a thermo-plastics material, and can be quickly and easily installed into engagement with the outlet
15 valve. Thirdly, the assembly can be used with an outlet valve which is also suitable for use in a separate cistern, thereby reducing production and inventory costs. Fourthly, the bracket enables an outlet valve to be fixed to the cistern in a manner allowing easy removal without requiring a nut on the (inaccessible) tail of the outlet valve.

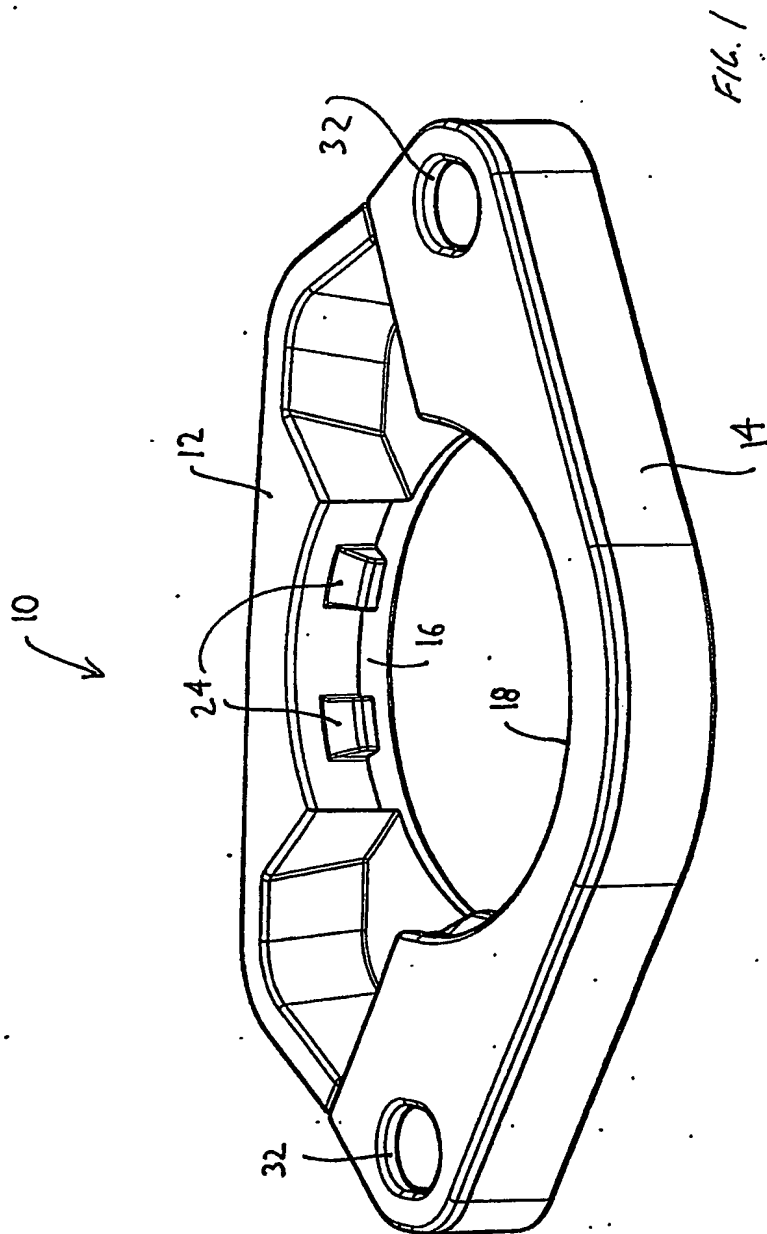
20 Although the invention has been described with reference to a specific example, it would be appreciated by those skilled in the art that the invention may be embodied in many other forms.

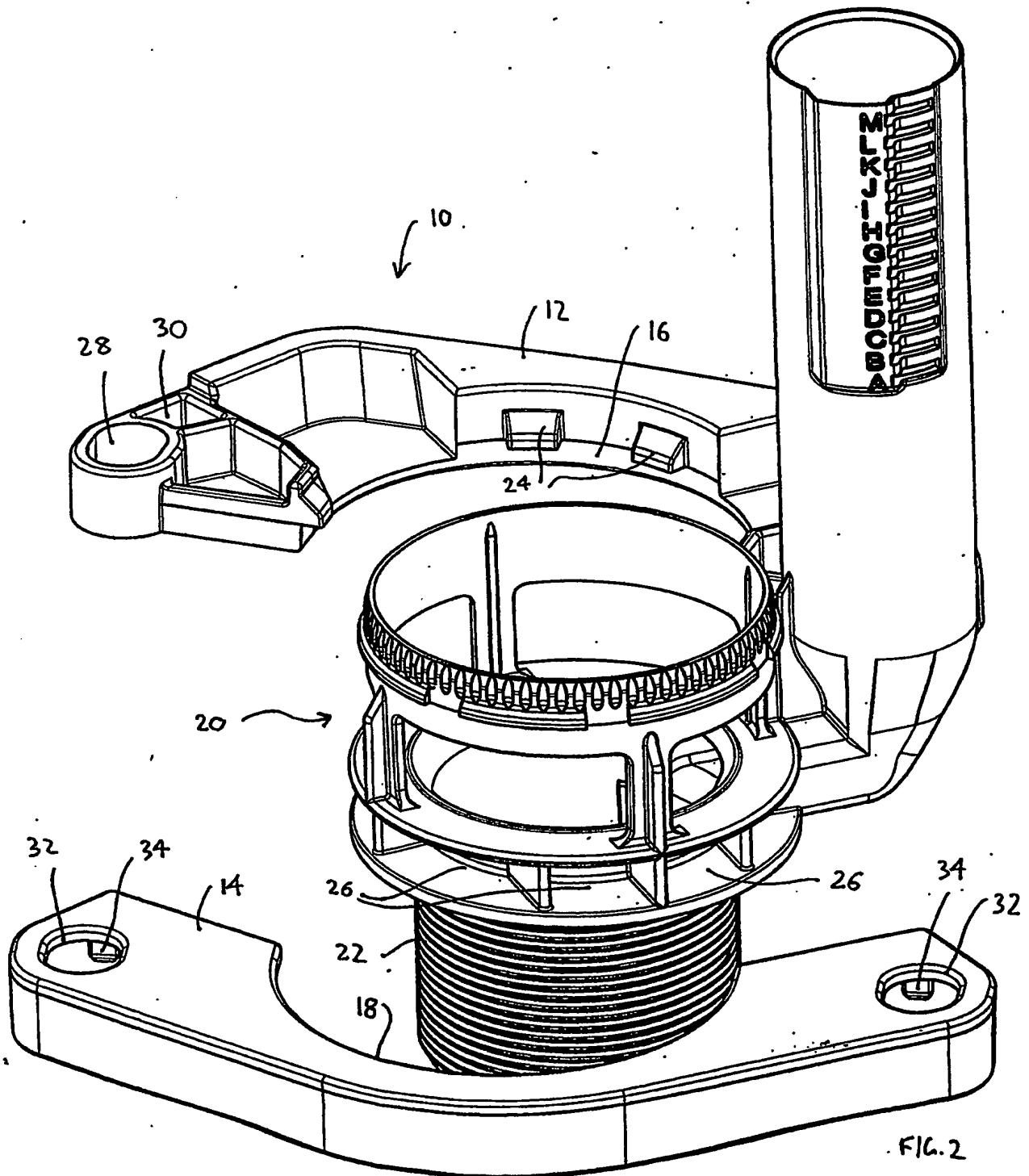
Dated 19 September 2002

Caroma Industries Limited

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SPRUSON & FERGUSON





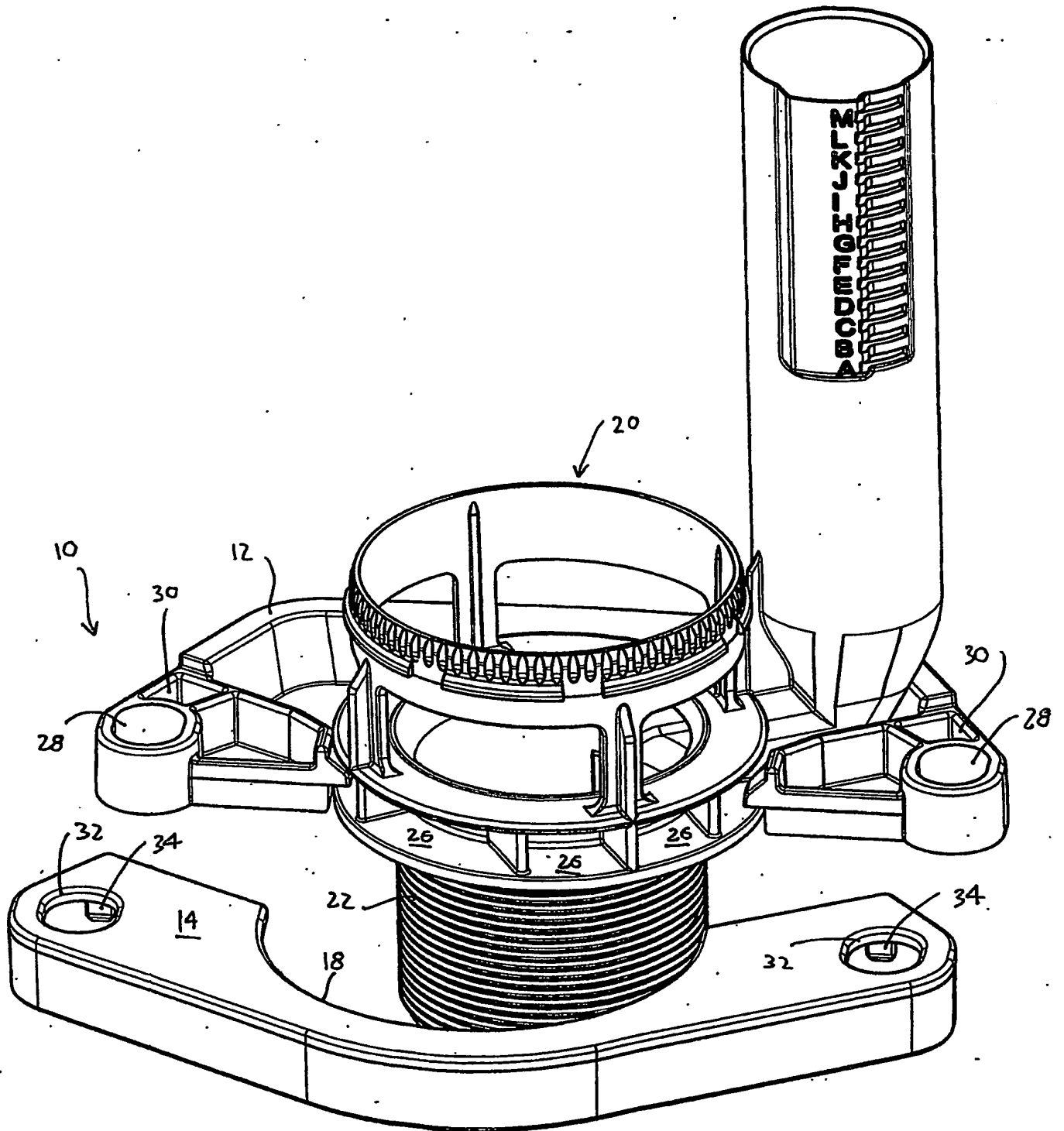


FIG. 3

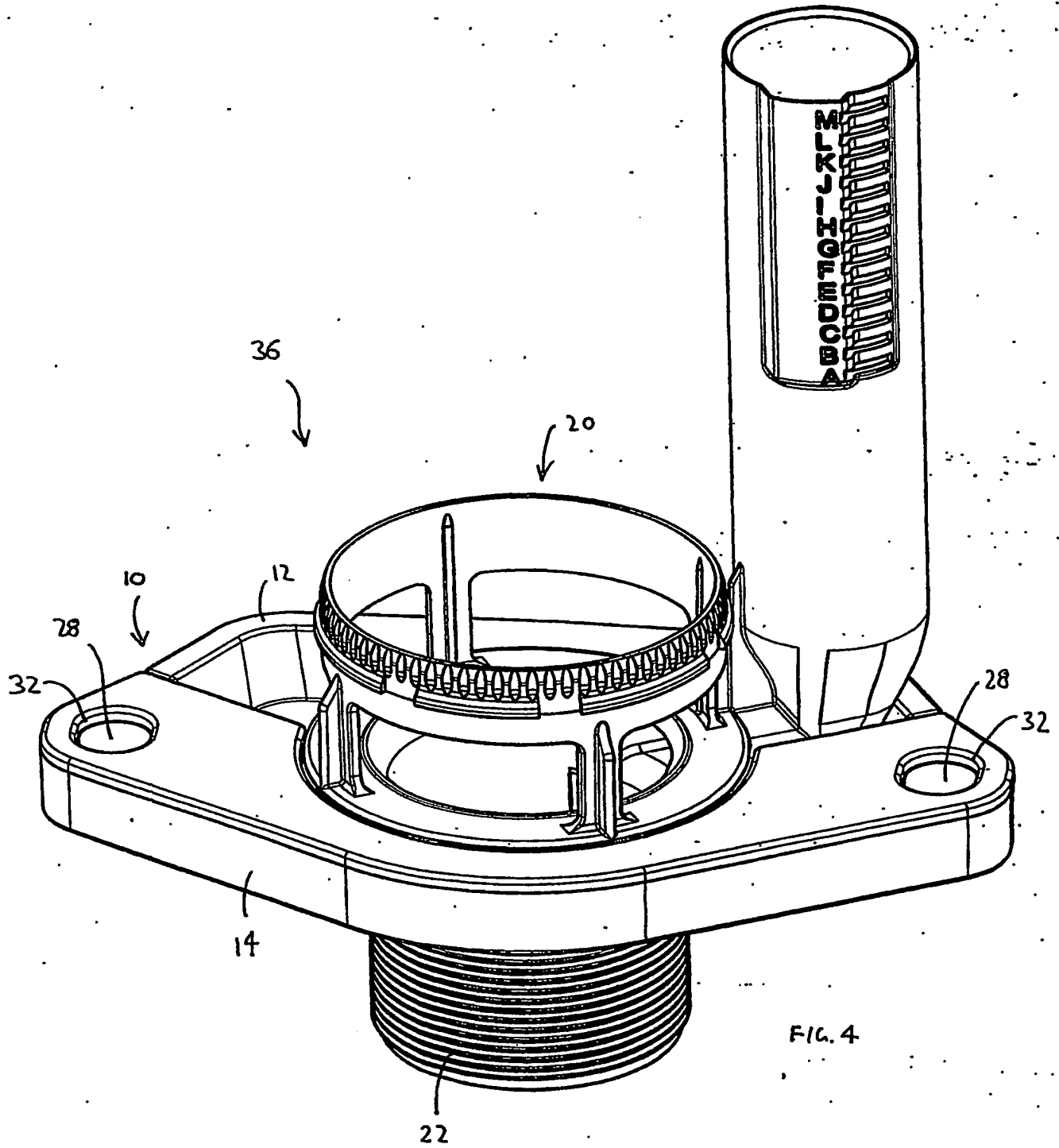


FIG. 4

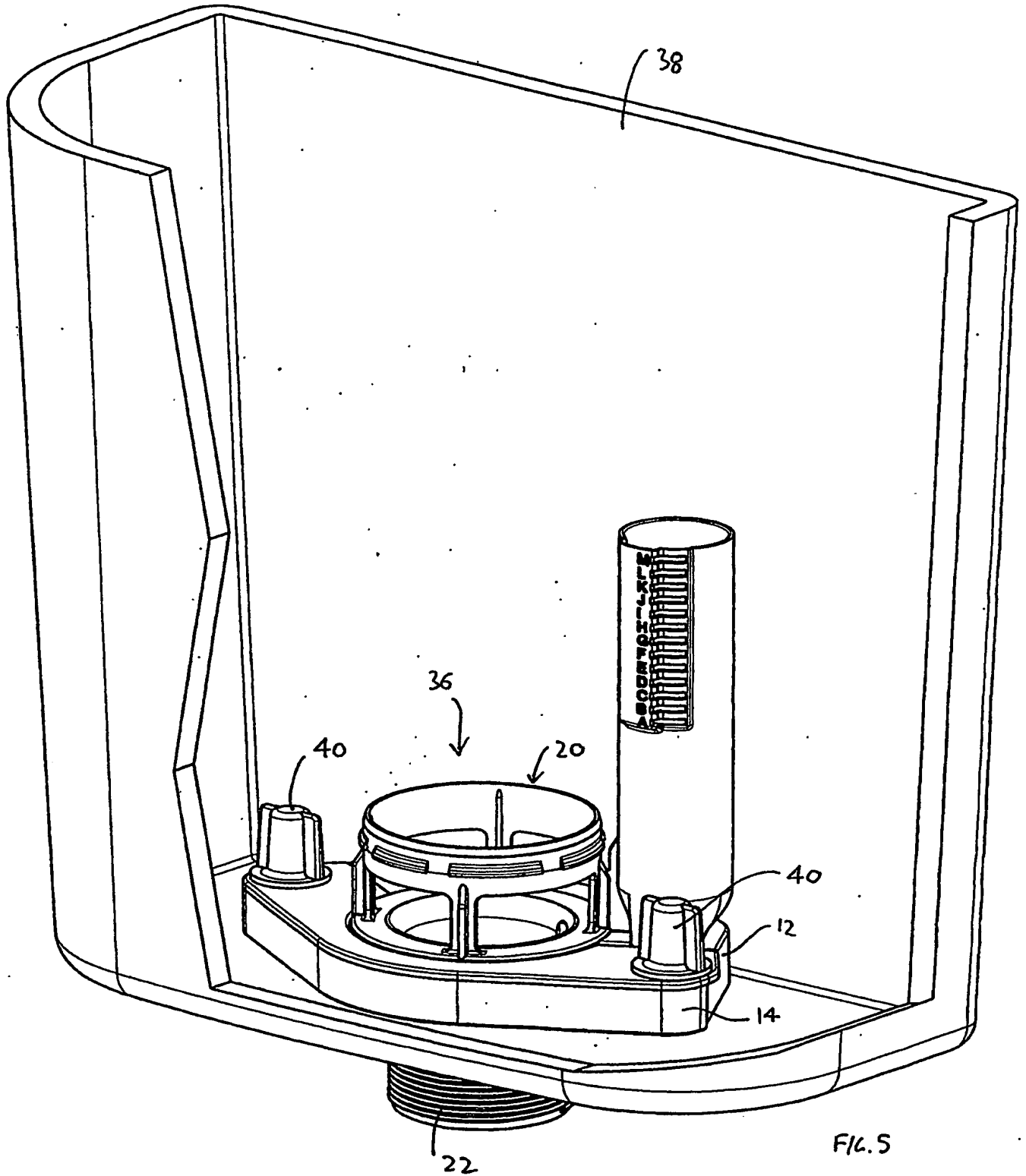


FIG. 5

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Applicant: BHP Billiton Innovation Pty Ltd.

Address for service: Griffith Hack, Melbourne.

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Application 2002951048

ECase Summary

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Title: ical Reduction of Beryllium Oxide In an Electrolytic Cell

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Close

AUSTRALIA
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PATENT REQUEST : PROVISIONAL APPLICATION

I/We, being the person(s) identified below as the Applicant(s), request the grant of a patent for an invention described in the accompanying provisional specification.

Applicant(s): BHP BILLITON INNOVATION PTY LTD
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Invention Title: ELECTROCHEMICAL REDUCTION OF BERYLLIUM
OXIDE IN AN ELECTROLYTIC CELL

**Name(s) of Actual
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DATED: 28 August 2002

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on behalf of the Applicant

AUSTRALIA
Patents Act 1990

PROVISIONAL SPECIFICATION

Applicant(s):

BHP BILLITON INNOVATION PTY LTD
A.C.N. 008 457 154

Invention Title:

ELECTROCHEMICAL REDUCTION OF BERYLLIUM OXIDE IN AN
ELECTROLYTIC CELL

The invention is described in the following statement:

ELECTROCHEMICAL REDUCTION OF BERYLLIUM OXIDE IN AN
ELECTROLYTIC CELL

5

The present invention relates to electrochemical reduction of beryllium oxide in a solid state in an electrolytic cell.

10

The present invention relates particularly to electrochemical reduction of beryllium oxide in a solid state to produce high purity beryllium metal in an electrolytic cell.

15

Beryllium metal has a combination of physical and mechanical properties, such as low weight, stiffness, resistance to corrosion from acids, transparency to X-rays and other electromagnetic radiation, and electrical and thermal conductivity, that make it useful for various applications in metal, alloy and oxide forms.

20

Beryllium metal is used principally in aerospace and defence applications. Its high stiffness, light weight, and dimensional stability within a wide temperature range make it useful in satellite and space vehicle structures, inertial guidance systems for missiles, military aircraft brakes, structural components of military aircraft, and space optical system components.

25

Beryllium alloys include beryllium-copper, beryllium-nickel, and beryllium-aluminium alloys, of which beryllium-copper alloys are the most important commercially. Beryllium-copper alloys are used in a wide range of applications that require electrical and thermal conductivity, high strength and hardness, good corrosion and fatigue resistance, and non-magnetic properties. Beryllium-copper strip is manufactured into springs,

30

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connectors, and switches for use in applications in automobiles, aerospace, radar, and telecommunications, factory automation, computers, and instrumentation and control systems.

5

Beryllium metal is extracted from beryllium oxide-containing minerals beryl ($3\text{BeO} \cdot \text{Al}_2\text{O}_3 \cdot 6\text{SiO}_2$) and bertrandite ($4\text{BeO} \cdot 2\text{SiO}_2 \cdot \text{H}_2\text{O}$) by chemical reduction. However, energy requirements and therefore production costs for producing beryllium by conventional chemical reduction technology currently being used are high.

10

An object of the present invention is to provide an alternative method of extracting beryllium metal from beryllium oxides.

15

The present invention was made during the course of an on-going research project on the electrochemical reduction of a range of metal oxides in a solid state in an electrolytic cell that is being carried out by the applicant.

20

During the course of the research project the applicant carried out experimental work on a range of different metal oxides in an electrolytic cell that included a graphite crucible that formed an anode of the cell, a pool of molten CaCl_2 -based electrolyte in the crucible, and a cathode that included solid metal oxides. One of the metal oxides tested by the applicant is beryllium oxide.

25

30

Accordingly, the present invention provides a method of reducing beryllium oxide in a solid state in an electrolytic cell, which electrolytic cell includes an anode, a cathode formed at least in part from beryllium oxide, and a molten electrolyte, the electrolyte including cations of a metal that is capable of chemically reducing

35

beryllium oxide, and which method includes a step of operating the cell at a potential that is above a potential at which cations of the metal that is capable of chemically reducing beryllium oxide deposit as the metal on the cathode, whereby the metal chemically reduces beryllium oxide.

The applicant does not have a clear understanding of the electrolytic cell mechanism at this stage.

10 Nevertheless, whilst not wishing to be bound by the comments in this paragraph, the applicant offers the following comments by way of an outline of a possible cell mechanism. The experimental work carried out by the applicant produced evidence of Ca metal in the

15 electrolyte. The applicant believes that, at least during the early stages of operation of the cell, the Ca metal was the result of electrodeposition of Ca^{++} cations as Ca metal on electrically conductive sections of the cathode. The experimental work was carried out using a CaCl_2 -based

20 electrolyte at a cell potential below the decomposition potential of CaCl_2 . The applicant believes that the initial deposition of Ca metal on the cathode was due to the presence of Ca^{++} cations and O^{--} anions derived from CaO in the electrolyte. The decomposition potential of CaO is

25 less than the decomposition potential of CaCl_2 . In this cell mechanism the cell operation is dependent at least during the early stages of cell operation on decomposition of CaO, with Ca^{++} cations migrating to the cathode and depositing as Ca metal and O^{--} anions migrating to the

30 anode and forming CO and/or CO_2 (in a situation in which the anode is a graphite anode). The applicant believes that the Ca metal that deposited on electrically conductive sections of the cathode was deposited predominantly as a separate phase in the early stages of

35 cell operation and thereafter dissolved in the electrolyte and migrated to the vicinity of the beryllium oxide in the cathode and participated in chemical reduction of

beryllium oxide. The applicant also believes that at later stages of the cell operation part of the Ca metal that deposited on the cathode was deposited directly on partially deoxidised beryllium oxide and thereafter
5 participated in chemical reduction of beryllium oxide. The applicant also believes that the O^{--} anions, once extracted from the beryllium oxide, migrated to the anode and reacted with anode carbon and produced CO and/or CO_2 and released electrons that facilitated electrolytic
10 deposition of Ca metal on the cathode.

The beryllium oxide may be any suitable type.

15 The beryllium oxide may be any suitable form.

By way of example, the beryllium oxide may be in the form of pellets.

20 Preferably the metal deposited on the cathode is soluble in the electrolyte and can dissolve in the electrolyte and thereby migrate to the vicinity of the cathode metal oxide.

25 It is preferred that the electrolyte be a $CaCl_2$ -based electrolyte that includes CaO as one of the constituents of the electrolyte.

30 In such a situation it is preferred that the cell potential be above the potential at which Ca metal can deposit on the cathode, i.e. the decomposition potential of CaO.

35 The decomposition potential of CaO can vary over a considerable range depending on factors such as the composition of the anode, the electrolyte temperature and electrolyte composition.

In a cell containing CaO saturated CaCl_2 at 1373K (1100°C) and a graphite anode this would require a minimum cell potential of 1.34V.

5 It is also preferred that the cell potential be below the potential at which Cl^- anions can deposit on the anode and form chlorine gas, i.e. the decomposition potential of CaCl_2 .

10 In a cell containing CaO saturated CaCl_2 at 1373K (1100°C) and a graphite anode this would require that the cell potential be less than 3.5V.

15 The decomposition potential of CaCl_2 can vary over a considerable range depending on factors such as the composition of the anode, the electrolyte temperature and electrolyte composition.

20 For example, a salt containing 80% CaCl_2 and 20% KCl at a temperature of 900K (657°C), decomposes to Ca (metal) and Cl_2 (gas) above 3.4V and a salt containing 100% CaCl_2 at 1373K (1100°C) decomposes at 3.0V.

25 In general terms, in a cell containing CaO- CaCl_2 salt (not saturated) at a temperature in the range of 600-1100°C and a graphite anode it is preferred that the cell potential be between 1.3 and 3.5V.

30 The CaCl_2 -based electrolyte may be a commercially available source of CaCl_2 , such as calcium chloride dihydrate, that partially decomposes on heating and produces CaO or otherwise includes CaO.

35 Alternatively, or in addition, the CaCl_2 -based electrolyte may include CaCl_2 and CaO that are added separately or pre-mixed to form the electrolyte.

It is preferred that the anode be graphite or an inert anode.

5 The applicant found in the experimental work that there were relatively significant amounts of carbon transferred from the graphite anode to the electrolyte and to a lesser extent, to the beryllium produced at the cathode under a wide range of cell operating conditions. Carbon in the beryllium is an undesirable contaminant. In
10 addition, carbon transfer was partially responsible for low energy efficiency of the cell. Both problems could present significant barriers to commercialisation of electrolytic reduction technology.

15 The applicant also found that the dominant mechanism of carbon transfer is electrochemical rather than erosion and that one way of minimising carbon transfer and therefore contamination of beryllium produced at the cathode by electrochemical reduction of beryllium
20 oxide is to position a membrane that is permeable to oxygen anions and is impermeable to carbon in ionic and non-ionic forms between the cathode and the anode and thereby prevent migration of carbon to the cathode.

25 Accordingly, in order to minimise contamination of beryllium produced at the cathode resulting from carbon transfer, it is preferred that the electrolytic cell includes a membrane that is permeable to oxygen anions and is impermeable to carbon in ionic and non-ionic forms
30 positioned between the cathode and the anode to thereby prevent migration of carbon to the cathode.

The membrane may be formed from any suitable material.

35

Preferably the membrane is formed from a solid electrolyte.

One solid electrolyte tested by the applicant is yttria stabilised zirconia.

5 According to the present invention there is also provided an electrolytic cell as described above and operating in accordance with the above described method.

10 The present invention is described further with reference to the following example and Figure 1.

I. Experimental Method and Electrolytic Cell

15 The electrolytic cell is shown in Figure 1.

20 With reference to Figure 1, the electrochemical cell included a graphite crucible equipped with a graphite lid. The crucible was used as the cell anode. A stainless steel rod was used to secure electrical contact between a d/c power supply and the crucible. The cell cathode consisted of Kanthal or platinum wire connected at one end to the power supply and a beryllium oxide pellet suspended from the other end of the wire. An alumina tube was used as an insulator around the cathode.

25 The cell electrolyte was a commercially available source of CaCl_2 , namely calcium chloride dihydrate, that partially decomposed on heating at the operating temperature of the cell and produced CaO . A thermocouple was immersed in the electrolyte in close proximity to the pellet.

30 The cell was positioned in a furnace and the experiment was conducted at 950°C . A voltage of 3V was applied between the crucible wall and the Kanthal or platinum wire for a period of 24 hours. The voltage of 3V is below the potential at which Cl^- anions can deposit on

the anode at that temperature.

The power-supply maintained a constant voltage throughout the experiment. The voltage and resulting cell
5 current were logged using LabVIEW (TM) data acquisition software.

At the end of the experiment the cell was removed from the furnace and quenched in water. The solid
10 CaCl_2 was dissolved by water and the pellet was recovered.

II. Experimental Results

The applicant found that the beryllium oxide
15 pellet had been completely reduced.

X-ray diffraction analysis of the pellet established that the reduced form of the beryllium oxide was Be_{13}Ca .
20

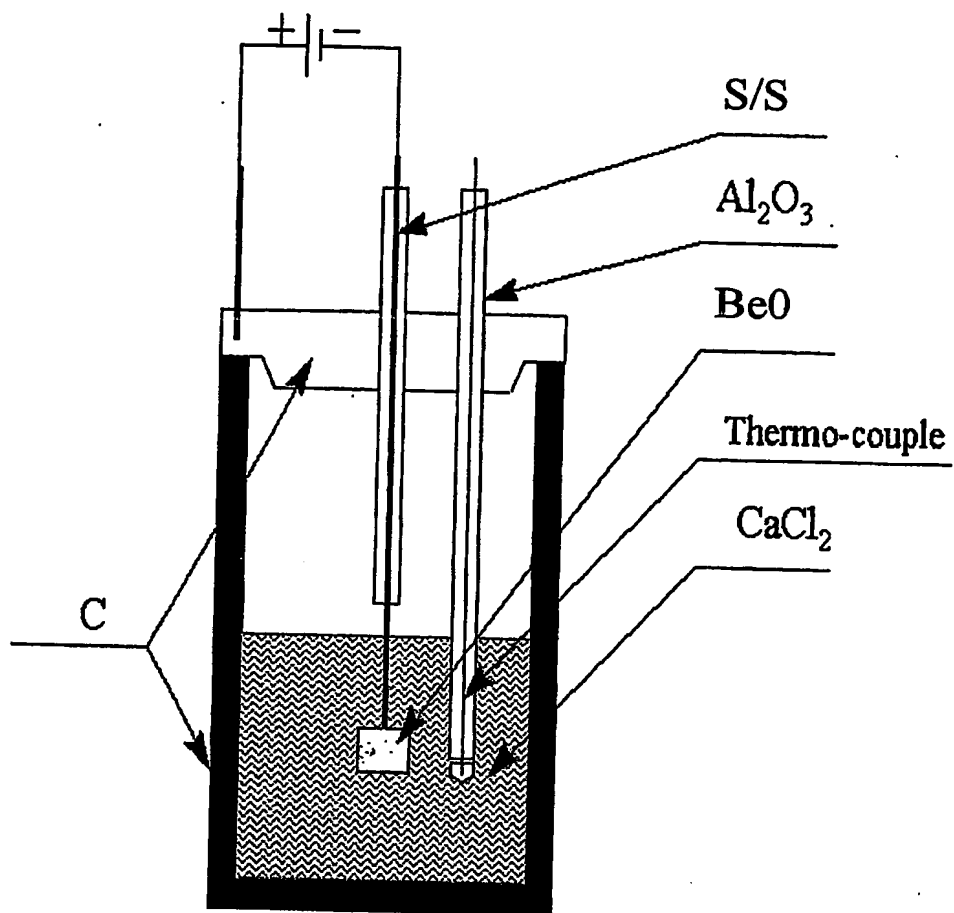
If necessary from the viewpoint of end use applications, the calcium could be removed from the Be_{13}Ca by further treatment, such as preferential dissolution of calcium in a suitable acid, eg acetic acid, or heating to
25 a molten state and vacuum degassing.

Many modifications may be made to the present invention as described above without departing from the spirit and scope of the invention.
30

By way of example, whilst the above description focuses on CaCl_2 -based electrolyte, the invention is not so limited and extends to any other suitable electrolytes (and mixtures of electrolytes). Generally, suitable
35 electrolytes will be salts and oxides that are soluble in

salts. One example of a potentially suitable electrolyte is BaCl_2 .

5 Dated this 28th day of August 2002
BHP BILLITON INNOVATION PTY LTD
By their Patent Attorneys
GRIFFITH HACK
Fellows Institute of Patent and
10 Trade Mark Attorneys of Australia



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